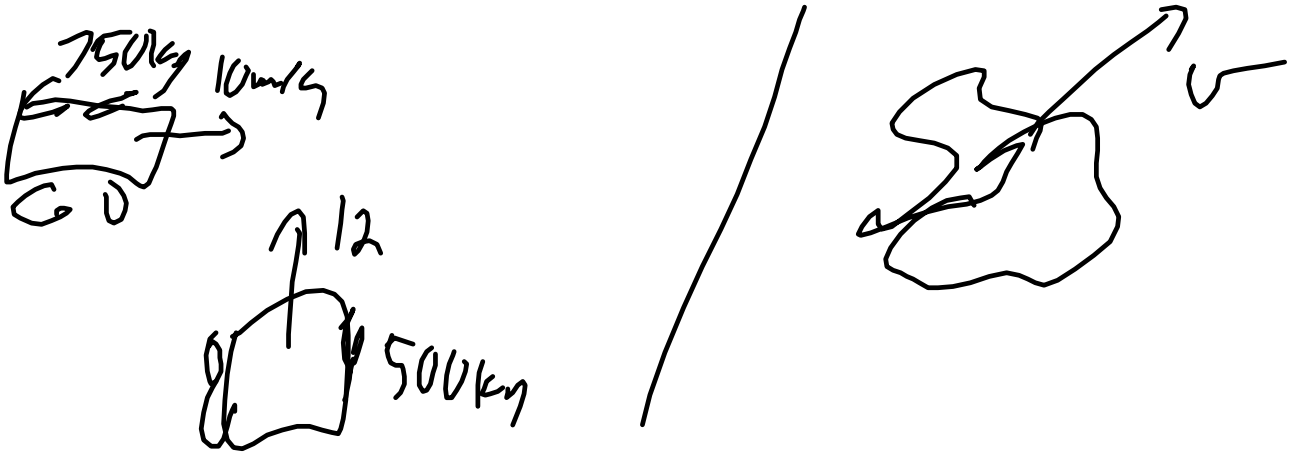
Momentum questions - electrostatics intro

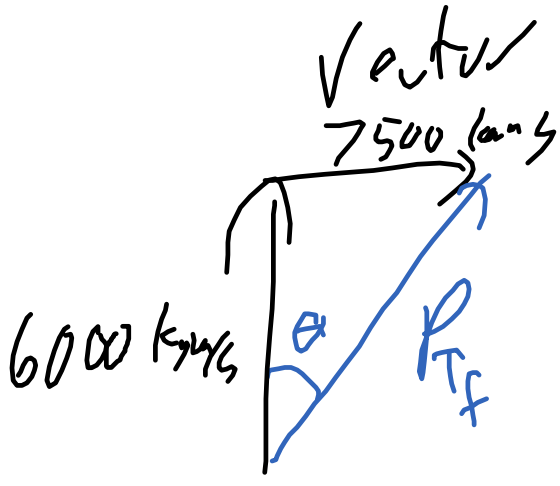
1. A 500.0 kg car moving north at 12.0 m/s collides with a 750.0 kg car moving East at 10.0 m/s. What is the velocity of the 500 kg car after the collision if

a) they stick together

b) the 750.0 kg car bounces off at 5.0 m/s 50.0º North of East. Was it an elastic collision? Are these realistic numbers?



$\sum p_i = \sum p_f$

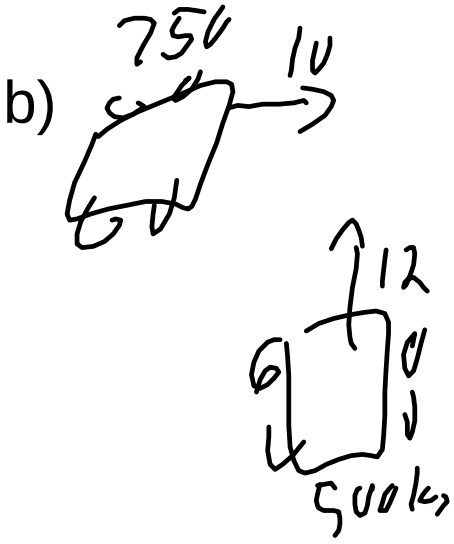


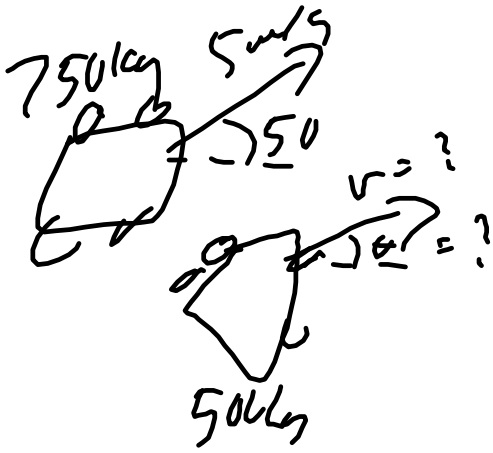
pf = Sqrt(7.5^2+6.0^2)=
9.60468356149272
9 605kgm/s
v=p/m
9604.68356149272/(500+

750)=7.683749084919
7.68 m/s

θ = Atan(7.5/6)=
51.34019174590991
7.68m/s 51.3º EofN (or 39º NofE)

b)





$$East \quad 7500\ kgm/s = 750 \times 5 \times \cos 50^\circ + 500 \times v_x$$

$$v_x = (7500-(750x5xCos(50)))/500=10.17909292735095$$

North 6000 = 750x5xSin(50) + 500vy
vy = (6000-750x5xSin(50))/500=
6.254666676607665 (if there was a negative result, the direction would be reversed - South)

v = Sqrt(10.179^2+6.2547^2)=
11.94710479949013

θ = Atan(6.2546666676607665/10.17909292735095)= 31.56914810232037

it moves at 11.9 m/s 31.6º North of East

was it elastic?
$1/2mv^2$ conserved?
0.5x(750)x(10)^2+0.5x(500)x(12)^2=73,500 J before the collision
0.5x(750)x(5)^2+0.5x(500)x(11.9)^2=44,777.5 J of the system after the collision

73000 is not equal to 45 000

so not elastic
were these values realistic?
Calvin - sure -
Alvina - cars masses are a bit small
assumes not friction

where did the 73000-45000=28000 J of lost energy go?

heat, sound, deformation of the metal

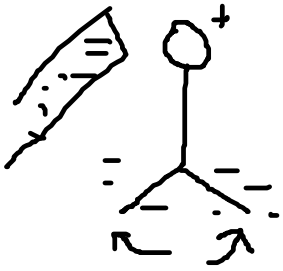
Electrostatics

demonstrations:

Rub a vinyl strip and bring it near a pith ball, the pith ball gets attracted.

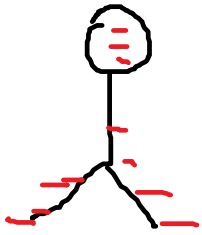
vinyl strip gets a negative charge

if you bring the strip near an electroscope - metal leaves that spread apart.

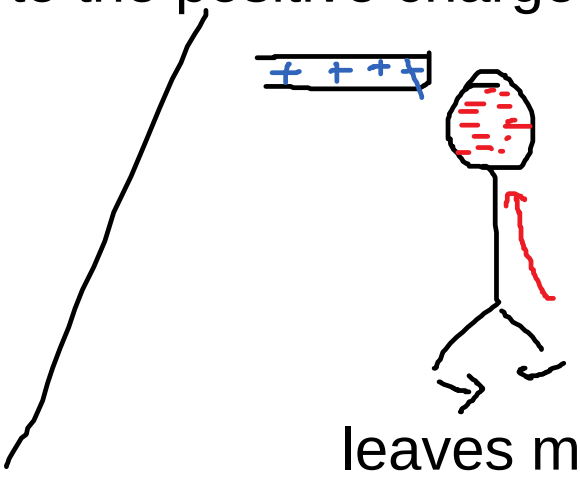


the negatively charged electrons are pushed away from the vinyl strip. Like charges repel.

If the electroscope is charged negatively and a positive glass rod is brought near, the leaves move together because the electrons are attracted to the positive charge



negative



leaves move together when an opposite charge is near

The balloon sticks to the wall because the charge on the wall redistributes - positive attracted negative repelled - there is a net attraction because the positive charge is closer.

We can conclude that electrostatic force is related to distance. closer = stronger.

this is also why the pith ball is attracted

There is a quantity called charge, q, Q.
(Q is also used for heat) QAQ

Charges can be positive (protons, up quarks, positrons)

negative (electrons, down quarks, muons,)

composite neutral - (balance of negative and positive - these can redistribute and attract charge)

fundamental neutral (neutrinos, photons, Wimps? - possible candidate for dark matter)

like particles repel
opposites attract
composite neutral can be attracted or not - depending on if the charge can restribute)
fundamental neutral are not attracted by charge

units: Coulomb, C - IB question - not! a fundamental SI unit - for historical reasons. Ampère, A is the SI base unit and Coulomb is derived

e is the fundamental charge

charge of an electron or proton is
$1.602 \times 10^{-19} C = e$
electron -1.602×10^{-19} C, proton is $+1.602 \times 10^{-19}$ C